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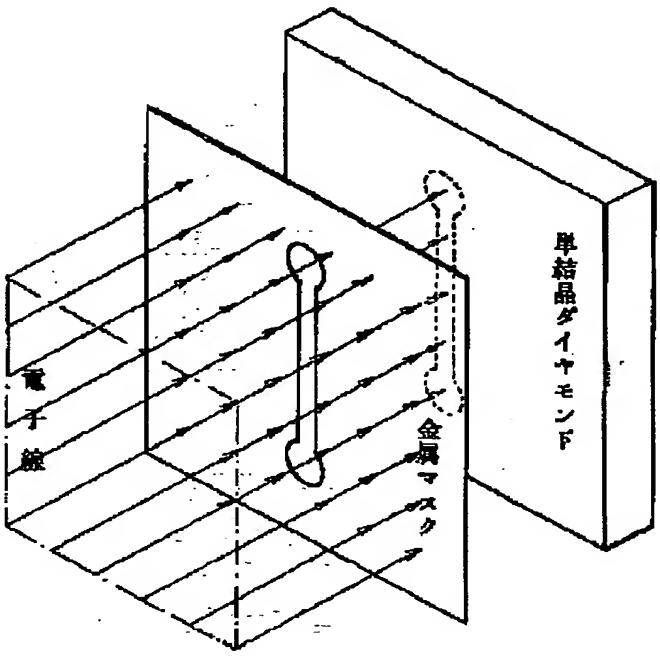
TITLE : METHOD FOR FORMING N-TYPE AND P-TYPE DIAMOND



ABSTRACT : PURPOSE: To prevent the breakage of crystal by applying an electron beam to a diamond in contact with a dopant such as B, Al, N, P and As, thereby activating the surface and diffusing the dopant into the diamond.

CONSTITUTION: A high-quality diamond film is epitaxially grown on an artificial single crystal diamond substrate by CVD process, etc. An n-type or p-type dopant such as B, Al, N, P or As is deposited on the surface of the substrate by vacuum evaporation. A screen composed of a metallic mask having a slit with a prescribed pattern is placed in front of the substrate. Electron beam is radiated through the screen at an acceleration voltage of 100eV to 1KeV to effect the diffusion of the dopant without destructing the crystal of the substrate corresponding to the opened part of the metallic mask.

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LOCALIZED SEMICONDUCTOR DIFFUSIONS UTILIZING LOCAL LASER MELTING IN DOPING ATMOSPHERES

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FIG. 1

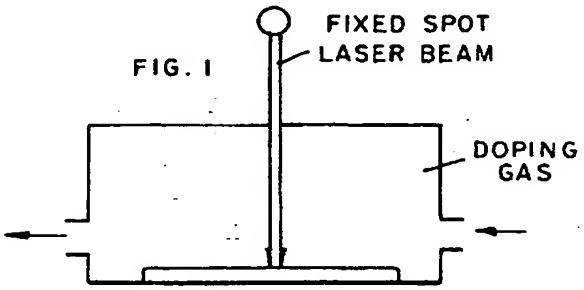


FIG. 2

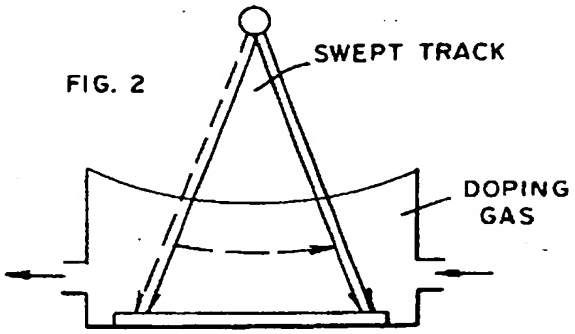
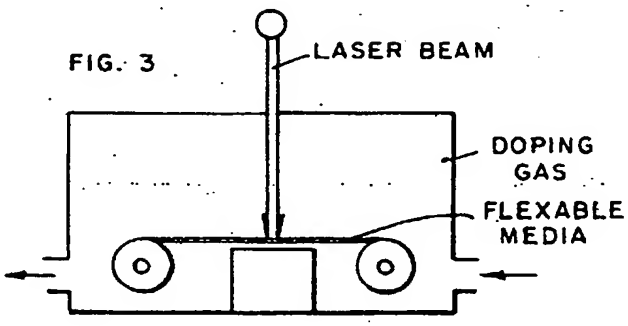


FIG. 3



It is known that laser melting of thin semiconductor films can be used to fabricate devices on insulating substrates. It is also known that dopant incorporation can be obtained during the film deposition or afterward by, for example, ion implantation.

This description teaches that localized laser induced diffusions can be performed on regular semiconductor substrates, or thin-film deposits on insulating substrates (large area-low cost application).

The method is simple in concept, and the investigation of parameters can be relatively straight forward.

A swept laser beam, or perhaps an electron beam of sufficient residence-time x power to melt a local semiconductor area (path) or a fixed pulse of sufficient time x power to melt a spot, can melt in an atmosphere of the proper concentration of doping atoms, to provide the finished melted zone with the proper resistivity and carrier concentration for the device characteristics desired. The diffusion only occurs in the melted region, the adjacent regions will be largely unaffected by

the process. The heating is local, therefore adjacent devices are untouched by the diffusion process. Also it is possible to do many kinds of devices on one chip with any combination of diffusion steps, because of the local nature of the process.

The regulation of the process would be in regulating laser beam power density and sweeping or fixed spot irradiation times, and the concentration of doping atoms in the doping atmosphere. All of these parameters can be controlled rather well, as shown in Figs. 1 and 2.

One extension of this idea is the fabrication of devices on flexible media, i.e., magnetic tape where diffusion temperatures would certainly ruin the tape. Local diffusions into thin film semiconductor material on the tape could be performed without degrading the tape, perhaps by depositing the semiconductor material on a reflector which reflects much of the nonabsorbed and absorbed heat away from the tape media. This could even be done in a continuous fashion, as shown in Fig. 3.